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The relationship between coronary calcium and traditional cardiac risk factors in men and women with no known cardiac disease

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The Relationship Between Coronary Calcium and Traditional Cardiac Risk Factors

in Men and Women with No Known Cardiac Disease
(TITLE)

BY

Tasha Thursby

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ABSTRACT

The purpose of this study was to determine the relationship between the coronary calcium score and traditional cardiac risk factors in men and women with no known cardiac disease. A second purpose was to determine if there were gender differences in the risk factors that best predict high coronary calcium scores. It was hypothesized that there would be a positive relationship between the coronary calcium score and traditional cardiac risk factors in men and women with no known cardiac disease. It was also hypothesized that there would be gender differences in the risk factors that best predict high coronary calcium scores.

The subjects for this study were voluntary participants in the health education program, "*Heart to Heart*", at Sarah Bush Lincoln Health Center in Mattoon, Illinois. There were 40 women and 41 men that were recruited for this project.

The health providers who conducted the "*Heart to Heart*" program were contacted for permission to use their facility, resources, and participants to acquire information through a voluntary questionnaire. Men and women from the Coles County area who had no known cardiac disease prior to receiving their health assessments were selected to participate in this study. The health assessments included: measures of total cholesterol, high density lipoprotein cholesterol levels, low density lipoprotein cholesterol levels, fasting blood glucose, height, weight, body mass index, computed tomography (CT) calcium score, blood pressure, age, and gender.

Descriptive statistics and Independent t-tests ($p \leq .05$), were used to assess the baseline data. Diastolic blood pressure ($t(1,77)= 16.94$, $p=.000$), total cholesterol

($t(1,79)= 9.33$, $p=.003$), and HDL cholesterol levels ($t(1,79)= 15.87$, $p=.000$) were significantly different between the men and women. Pearson Product-Moment correlations were performed to determine if there were significant correlations between risk factor variables and coronary calcium scores. Significant relationships were found between age, systolic blood pressure, diastolic blood pressure and blood glucose with coronary calcium among all subjects. Among the men, systolic blood pressure and diastolic blood pressure were the only factors that showed a significant relationship to coronary calcium. Data from the females showed age and blood glucose level to be significantly related to the calcium score. Multivariate stepwise regression ($p \leq .05$), was performed to assess the relationship between traditional cardiac risk factors and coronary calcium for all subjects and for females and males separately. The analysis showed that systolic blood pressure was the only significant predictor of coronary calcium among all subjects. When the subject data was analyzed separately, the significant predictor among men was systolic blood pressure ($p=.001$) while age ($p=.002$) was the only variable among the women to significantly predict coronary calcium.

Based on this study, it can be concluded that women with the risk factors of increasing age and high blood fasting glucose and men with the risk factors of high systolic blood pressure and high diastolic blood pressure should have a coronary calcium test performed to determine prevention or treatment methods.

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CHAPTER I

INTRODUCTION

Cardiovascular disease continues to be the leading cause of death in the United States (American Heart Association, 2005). Atherosclerotic coronary heart disease is a process in which deposits of fatty substances, cholesterol, cellular waste products, calcium and other substances build up in the inner lining of an artery. It usually affects large and medium sized arteries (AHA, 2005a). Coronary heart disease (CHD) starts during childhood and progresses with age (AHA, 2005a). During this period of time, biological risk factors and environmental influences promote the development of atherosclerotic plaque. The traditional cardiac risk factors, as defined by the American College of Sports Medicine (2006), play a major role in the development of CHD. These cardiac risk factors may not always be associated with symptoms; therefore, additional methods are needed to identify CHD.

Electron-Beam Computed Tomography (EBCT or Ultra fast CT) is an especially fast, non-invasive, x-ray technology that can be used to measure the location and extent of calcified plaque in the coronary arteries. The amount of calcium that is present in the coronary arteries is referred to as the coronary calcium score. The calcium score is a good indicator of whether coronary artery disease is present or if it is likely to develop in the next few years, despite a lack of symptoms (Radiology Info, 2005a).

Several studies have investigated the association between cardiovascular risk factors and coronary calcification. The Rotterdam Coronary Calcification Study examined associations between cardiovascular risk factors and coronary calcium scores seven years prior to and concurrent to scanning by electron beam tomography (Oei, Vliegenthart, Hofman, Oudkerk, Witteman, 2004). This study used 2,013 asymptomatic participants for analyses and found that cardiovascular risk factors are associated with coronary calcification. Associations were stronger for risk factors measured at an early age. The study also showed that almost 30% of the men and 15% of the women without risk factors had extensive coronary calcification (Oei et al., 2004). This is just one example of why it is important to find the relationship between risk factors and coronary calcification. Another study concluded that there are significant correlations and risk factor associations for calcified atherosclerosis in different vascular beds of 650 asymptomatic subjects (Allison, Criqui, Wright, 2003). Similar studies support the correlation between cardiac risk factors and coronary calcification; Johns Hopkins Medical Institutions, 2005; Megnein, Simon, Lemariey, Plainfosse, Levenson, et al.,1996; Moser, O'Keefe, Bateman, McGhie et al., 2003; Shaw, Raggi, Schisterman, Berman, Callister etal., 2003; Taylor, Bindeman, Feuerstein, Coa, Brazaitis, O'Malley, et al., 2005; Wexler, Brandage, Crouse, Detrano, Fuster, Mddahi et al., 1996; Wilson, Hoeg, D'Agostino, Silbershatz, Belanger, Poehlmann et al., 1997.

Conversely, other studies found no association between coronary calcium and tradition cardiac risk factors. Detrano et al. (1999) showed that coronary calcium and cardiac risk factors were not associated with one another. The study was completed with 1,196 asymptomatic high coronary risk subjects. The subjects were classified as

asymptomatic high coronary risk after undergoing risk factor assessment according to the Framingham Model and EBCT scanning. There was a follow up period of 41 months. The Framingham model and a data-derived risk model were used to determine the three year likelihood of a coronary event. In conclusion, the study found that neither risk factor assessment nor EBCT calcium was an accurate event predictor in high risk asymptomatic adults. The calcium score did not add significant information to risk factors, and therefore could not justify EBCT scans at the time of the study (Detrano., Wong, Doherty, Shavelle, Tany, Ginzton et al.,1999). Other studies that found no association between coronary calcium and cardiac risk factors were completed by the following authors: Pitt & Rubenfire, 1999; Taylor, Watkins, Bell, Carrow, Bindemen, Scherr, et al., 2002.

Research is needed to discover if there are any single cardiac risk factors or a specific group of risk factors that can predict high coronary calcium scores. These results could help in determining if a person is at risk for developing cardiac disease and could be useful for either prevention or treatment of cardiac disease.

Statement of Purpose

The purpose of this study was to assess the relationship between the coronary calcium score and traditional cardiac risk factors in men and women with no known cardiac disease and to determine if there were gender differences in the risk factors that best predict high coronary calcium scores.

Hypotheses

1. There will be a positive relationship between the coronary calcium score and traditional cardiac risk factors in men and women with no known cardiac disease.
2. There will be gender differences in the risk factors that best predict high coronary calcium scores.

Limitations

The subjects in this study were participants in a health program at one Central Illinois health center in a primarily rural community. A small sample size was used to collect data. The subjects were exclusively Caucasian, limiting ethnic diversity in the study.

Definitions

Atherosclerosis: The narrowing and hardening of the arteries due to fatty plaque build up (AHA, 2005b).

Coronary artery calcium (CAC): Build up of calcium within the coronary arteries (AHA, 2005b).

Coronary artery disease (CAD): A condition caused by thickening of the walls of the arteries that supply blood to the heart muscle (American Heart Association [AHA], 2005b).

Cardiac risk factor: Any condition or factor that can increase the risk of developing a cardiac disease (AHA, 2005b).

Coronary calcium score: A number derived from EBCT scans that is used to diagnose CAD and to determine its severity (RadiologyInfo, 2005a).

Electron beam tomography scan (EBCT): An especially fast form of X-ray imaging technology that can measure calcium deposits in the coronary arteries (AHA, 2005a).

CHAPTER II

REVIEW OF LITERATURE

It was the purpose of this study to assess the relationship between the coronary calcium score and traditional cardiac risk factors in men and women with no known cardiac disease. A second purpose was to determine if there were gender differences in the risk factors that best predict high coronary calcium scores.

This chapter presents a review of related literature in the areas of coronary heart disease, cardiac risk factors, risk factors specific to women, coronary calcium, the relationship between coronary calcium score and coronary risk factors, studies exclusively involving men, and studies exclusively involving women.

Coronary Heart Disease

The American Heart Association estimates that 71,300,000 Americans have one or more forms of cardiovascular disease (CVD) (Thom et al., 2006). Preliminary mortality data showed that in 2003, CVD was an underlying or contributing cause of death in about 58 percent of all deaths. CVD claims more lives each year than the next four leading causes of death combined, which are cancer, chronic lower respiratory diseases, accidents and diabetes mellitus (Thom et al., 2006). According to a report from the American Heart Association Statistics Committee and the Stroke Statistics Subcommittee (Thom et al., 2006), over 152,000 Americans killed by CVD each year are under the age of 65. Coronary heart disease (CHD) is one of the most common forms of CVD. Based on the National Heart, Lung and Blood Institute's (NHLBI) Framingham

Study, CHD comprises more than half of all cardiovascular events in men and women under age 75 (Thom et al., 2006). The lifetime risk of developing CHD after age 40 is 49 percent for men and 32 percent for women. Coronary heart disease caused one of every five deaths in the United States in 2003, making CHD as an underlying or contributing cause of death for 653,000 Americans (Thom et al., 2006).

Cardiac Risk Factors

The Framingham Heart Study has played a major role in defining the contribution of risk factors to CHD occurrence in the general population of the United States. Cardiovascular risk factors that have been extensively studied at Framingham include cigarette smoking, hypertension, high serum cholesterol and various cholesterol fractions, low levels of high density lipoprotein (HDL) cholesterol, and diabetes mellitus. Advancing age is also included as a risk factor in the Framingham charts (Grundy et al., 1998). Other major risk factors for increasing the likelihood for developing CHD are obesity, physical inactivity, family history of premature CHD, hypertriglyceridemia, and elevated low density lipoprotein (LDL) cholesterol (Grundy et al., 1998) . Although they are not included in risk charts, Framingham research reveals that both obesity and physical inactivity are positively associated with risk for CHD. Framingham data also indicates that a positive family history and elevated serum triglycerides are a risk correlate (Grundy et al., 1998).

The American Heart Association Statistics Committee and the Stroke Statistics Subcommittee reported statistics for the prevalence, mortality and the number of hospitalizations for 2003. The risk factors that were included in this report were: tobacco

use, high blood cholesterol and other lipids, physical inactivity, overweight and obesity, and diabetes mellitus (Thom et al., 2006). According to the report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee (2006), current cigarette smoking is a powerful independent predictor of sudden cardiac death in patients with CHD and results in a two to three fold risk of dying from CHD. When the statistics for high blood cholesterol and other lipids were conducted, it was reported that a 10% decrease in total cholesterol levels (population wide) may result in an estimated 30% reduction in the incidence of CHD. The relative risk of CHD associated with physical inactivity is an increased risk that is comparable to the risk that is observed for high blood cholesterol, high blood pressure or cigarette smoking (Thom et al., 2006). According to the World Health Organization as stated in the report by the American Heart Association Statistics Committee and Stroked Statistics Subcommittee (2006), excessive weight and obesity are major risk factors for CVD. An estimated 70% of diabetes risk in the United States can be attributed to excess weight. Heart disease death rates among adults with diabetes are two to four times higher than the rates for adults without diabetes. At least 65% of people with diabetes mellitus die of some form of heart or blood vessel disease (Thom et al., 2006).

In the Rotterdam Coronary Calcification Study, age, body mass index, systolic blood pressure, diastolic blood pressure, total cholesterol, HDL cholesterol, diabetes and smoking were used as risk factors (Oei, Vliegenthart, Hofman, Oudkerk, & Witteman, 2004). According to the American College of Sports Medicine, the following are positive risk factors for CHD: family history, cigarette smoking, hypertension,

dyslipidemia (including low HDL and elevated LDL) ,impaired fasting glucose, obesity, and sedentary lifestyle (Armstrong et al., 2006).

At present, the preponderance of research has shown the following risk factors to be of greatest concern in relation to CHD (Armstrong, et al., 2006; Grundy et al., 1998; Oei et al., 2004).

- **Family history**: myocardial infarction, coronary revascularization, or sudden death before 55 years of age in father or other male first-degree relative, or before 65 years of age in mother or other female first-degree relative.
- **Cigarette smoking**: current cigarette smoker or those who quit within the previous 6 months.
- **Hypertension**: being diagnosed as hypertensive or on antihypertensive medication
- **Dsylipidemia**: total serum >200 mg· dL^{-1}; LDL >130 mg· dL^{-1} > 100 mg· dL^{-1} if high risk; HDL < 40 mg· dL^{-1}, ideally <50 mg· dL^{-1} for women; triglycerides >150 mg· dL^{-1}, ideally >100 mg· dL^{-1}.
- **Impaired fasting glucose**: fasting blood glucose ≥ 100 mg dL, confirmed by measurements on at least two separate occasions, or on medication.
- **Obesity**: Body Mass Index (BMI) >30 kg/m^2.
- **Sedentary lifestyle**: persons not participating in a regular exercise program or not meeting the minimal physical activity recommendations of accumulating 30 minutes or more of moderate physical activity on most days of the week, from the U.S. Surgeon General's Report.

Risk Factors Specific to Women

In a recent study, Christian, Harrington, Edwards, Oberg, and Fitzpatrick (2002) concluded that estrogen status is associated with increased coronary calcium and plaque area, independent of age and CHD risk factors. Estrogen may modulate the calcium content of atherosclerotic plaques, as well as plaque area and may slow the progression of atherosclerosis in women. This study suggests that post-menopausal women, treated with estrogen replacement therapy, have a significantly reduced risk of CHD and less extensive coronary calcification than untreated women (Christian et al., 2002). The authors obtained coronary arteries at autopsy from 56 white women age 18-98 years old. Forty six women were post-menopausal and 10 were pre-menopausal. Inpatient and outpatient medical records from the Mayo Clinic were reviewed for demographics, CHD risk factors, menstrual status and use of estrogen replacement therapy. The data strongly indicated that estrogen status remained an independent predictor of coronary calcium and plaque. Christian et al., 2002 suggested that coronary calcification and plaque formation may progress at different rates in the presence of estrogen. Estrogen may inhibit progression of atherosclerosis and associated calcification in aging women and was associated with a significantly lower calcium-to-plaque ratio in postmenopausal women (Christian et al., 2002).

In the State of the Art Diagnostic Testing in Women Research Update by Shaw, Johnson, Meires, Redberg, and Merz (2002), it was stated that the incidence of coronary disease is decreased in pre-menopausal women, due to endogenous estrogen. As women enter the perimenopausal state there is a loss of estrogen. By the time a woman reaches age 55 years, she is considered post-menopausal and her estrogen levels are nearly 1/10

that of her pre-menopausal state. They conclude that the global risk of cardiovascular disease increases in the post-menopausal state and reaches equivalence to men by the time a woman is in her seventh decade. In the research update by Shaw etal. (2002), it is also mentioned that a number of studies have noted that coronary disease may be masked for the women taking hormone replacement therapy due to its vasodilatory action; resulting in a reduced frequency of chest pain and ischemia as well as improved exercise tolerance.

Coronary Calcium

Coronary artery calcium is a marker of atherosclerosis in asymptomatic subjects (Janowitz, Agatston, Kaplan, & Viamonte, 1993). Atherosclerosis is a slow, complex disease that typically starts in childhood and progresses with age. Modifiable risk factors can increase the progression of atherosclerosis, where as factors such as age, gender, and family history cannot be modified (American Heart Association, 2005b). When biological risk factors interact with genetic and environmental influences, coronary calcification is initiated and begins to develop plaque (LaMonte et al., 2005). Unfortunately, once CAD is established, the absence of signs or symptoms may occur. Myocardial infarction or death is frequently associated with the presence of the disease.

Researchers at the Cooper Institute examined the association between coronary artery calcium and the incidence of CHD in a large cohort consisting of 16,097 asymptomatic adults free of known CHD at baseline (LaMonte et al., 2005). They investigated whether the association between coronary artery calcium (CAC) and CHD was independent of prevalent CHD risk factors. The subjects underwent electron beam

computed tomography (EBCT) scanning as part of a preventative health exam or because of physician or self referral. Men and women who had a coronary event were older, had higher CAC scores, and higher conventional risk factor values than same-sex, event free individuals. The results of this study showed a strong association between CAC scores and the incidence of CHD events. CAC is a significant predictor of fatal and nonfatal CHD events. These findings were consistent for men and women and held after adjustment for age and conventional CHD risk factors (LaMonte et al., 2005).

According to Arad et al. (1996), EBCT based screening for CAD showed great applicability to the development of CVD events in an initially asymptomatic middle aged population. In this study, 1,173 asymptomatic patients were followed for 19 months. The mean age was 53 years and 71% of the subjects were male. EBCT scanning was done on each subject and coronary calcium scores were reported. After the subjects were followed for 19 months, the relationship between CAC scores and coronary events was examined and found to be strongly correlated. Of the reported risk factors, only hypertension correlated with CAC scores at baseline and only age showed a positive correlation with subsequent atherosclerotic cardiovascular events (Arad etal.,1996).

Secc et al. (1997) argue that the amount of CAC appears to be a weak predictor of coronary death and infarction. This study also found that CAC predictive accuracy is superior for prediction of cardiovascular revascularization. The results were based on 1,461 subjects at high risk for coronary disease events who had neither experienced symptoms of coronary heart disease nor exhibited ECG evidence of prior infarction at the time of enrollment. Initially, the findings of this study demonstrated that both the presence of coronary calcium and the number of calcified vessels predicted coronary

events. However, 31% of subjects suffering an infarction or coronary death had no coronary calcium detectable by fluoroscopy, a real-time display of cardiac images. The study indicated that an imperfection in the predictive accuracy of the test may be due to factors involving the technical inferiority of fluoroscopy compared with EBCT. However it is unclear whether calcified plaques are more or less likely to rupture than non-calcified plaques causing serious coronary events such as infarction or stroke (Secc et al., 1997).

The Relationship Between Coronary Calcium Score and Cardiac Risk Factors

When comparing the relationship between the coronary calcium score and traditional cardiac risk factors, there are conflicting results. The Rotterdam Study showed a positive correlation between the coronary calcium score and cardiac risk factors in older adults (Oei etal., 2004). In the Rotterdam Coronary Calcification Study, age, body mass index, systolic blood pressure, diastolic blood pressure, total cholesterol, HDL cholesterol, diabetes and smoking were used as risk factors (Oei etal., 2004). The subjects were males and females 55 years and older. The study demonstrated that age and male sex are the most important risk factors for coronary calcification. Body mass index (BMI), systolic blood pressure, diastolic blood pressure, total cholesterol, diabetes and smoking measures seven years before scanning were positively associated with the calcium score, while HDL cholesterol was inversely associated with the calcium score. When the authors measured risk factors concurrent to EBCT scanning, the strength of the association did not change for BMI. However, systolic and diastolic blood pressure were not associated with the calcium score until subjects taking blood pressure lowering medication were excluded, then systolic blood pressure was positively associated with the

calcium score. The association of total cholesterol and the calcium score disappeared when cholesterol was measured at the same time as scanning. After exclusion of subjects on lipid lowering medication, total cholesterol was strongly associated with the calcium score in women while no association was present in men. High density lipoprotein cholesterol measured at the time of scanning was associated with the calcium score only in women, in men no association was present. The data showed weaker associations for blood pressure and cholesterol when the risk factors were measured at the time of the EBT scanning, compared to when the same risk factors were studied seven years before. The authors stated that this may be because more subjects were treated with medication at the time of the scanning than seven years prior to the scanning (Oei et al., 2004). The association between diabetes and coronary calcification was stronger when measured at the time of scanning in women, where as the strength of the association between diabetes and coronary calcification in men slightly decreased. Associations for smoking were also slightly stronger when measured at the time of scanning. At the time of scanning, 24% of the men and 12% of the women had a history of coronary artery disease. The subjects with a history of coronary artery disease had a five times higher calcium score than subjects without a history of coronary heart disease. Increased age had strong and graded associations with the calcium score. Men had calcium scores that were five times higher than in women. In men, median calcium scores increased from 81 in men aged 60-64 to 548 in men aged 80-85. In women, median calcium scores increased from 8 in women aged 60-64 to 135 in women aged 80-85. The number of cardiovascular risk factors was strongly associated with high calcium score. Fifty two percent of the men with three or

more risk factors had a high calcium score and 26 percent of women with three or more risk factors had a high calcium score (Oei et al., 2004).

Another study completed by Moser, O'Keefe, Bateman, and McGhie (2003), also examined the number of risk factors that are related to CAC. A retrospective analysis was performed on data from 794 asymptomatic patients who underwent CAC screening over an eight month period. Subjects were risk stratified according to the number of risk factors. Patients with three or more cardiac risk factors were more likely to exhibit moderate to severe CAC. A CAC score of 101-400 was considered moderate and a severe CAC score was greater than 400. Of the 794 patients, 422 had detectable CAC. Of these, 14% had a moderate CAC score and 9% had a severe CAC score. The authors also stated that risk factor assessment is poor at predicting which individuals will have CAC if fewer risk factors are present (Moser et al., 2003)

In a statement made for health professionals from the American Heart Association, Wexler, et al. (1996) summarized several investigators who have studied risk factors for their association with coronary artery calcifications. It was found that age and gender were the most important risk factors for coronary calcification, ranging from 14% risk for men and women less than 40 years old to a 93% to 100% risk for men older than 70 years old, and a 77% to 100% risk for women older than 70 years old (Wexler et al., 1996.)

In a study completed by Devries et al. (1995), the researchers found that younger women have a unique pattern of calcification which more closely resembles the male pattern only after women reach 60 years of age. This study demonstrates that coronary atherosclerosis in men is more likely to be associated with calcification than similarly

diseased arteries in women. The women in this study that were >60 years old had a calcification pattern indistinguishable from that in men of any age. In conclusion, Devries et al. (1995), found that patients without evidence of coronary calcification detected by ultra-fast computed tomography are highly unlikely to have obstructive coronary artery disease.

The other risk factors that have been shown to be associated with coronary calcification, in one or more studies in one or more patient groups, are diminished HDL, cigarette smoking, elevated blood pressure, obesity, number of risk factors, diabetes and elevated triglycerides, and the most consistent associated risk factor is elevated plasma cholesterol (Wexler et al. 1996).

Another study, that observed the prevalence and risk factors associated with coronary artery calcification in older adults to age 99, found that the extent of coronary artery calcification was strongly associated with age through the ninth decade in men and women and was associated with CVD (Newman et al., 2001). This study looked at 614 older adults with an average age of 80 years. CAC scores ranged from 0 to 5459 in both men and women. The participants that had a score of zero made up 9% of the participants, 6% of men compared with 11.4% of women. An additional 21.7% of the participants had a score < 100 and 54.7% had a score < 400. Fewer women than men had a score > 1000, 13% of women compared with 34% of men. Secondly, risk factor levels were only weakly associated with the extent of CAC in older adults (Newman et al.,2001).

According to Wilson et al. (1997) who studied a sample of 429 men and 661 women in the Framingham Heart Study, high systolic blood pressure, high cholesterol

levels, and smoking were associated with an increased risk of carotid stenosis in an elderly population with a mean age of 75 years. The study took into account that some risk factors, such as total cholesterol levels, typically peak in middle age and decline in the elderly; therefore, single evaluations of risk factors may underestimate associations with clinical or subclinical vascular disease in older people. The participants of this study were part of the Framingham Heart Study; therefore, the levels of cholesterol, HDL cholesterol, blood pressure and smoking at earlier examinations were calculated for each subject and separate analyses were performed for men and women. There were significant associations among men and women for systolic blood pressure, smoking and total cholesterol.

Cardiac risk factors such as family history of CHD, hypercholesterolemia, hypertension, smoking and diabetes were all prevalent in a study done by Shaw, Raggi, Schisterman, Berman, and Callister (2003). The study was completed to determine to what degree coronary calcium screening can predict events in an asymptomatic population and whether coronary calcification adds to our ability to assess risk. Ten thousand, three hundred seventy seven asymptomatic individuals underwent cardiac risk factor evaluation according to the National Cholesterol Education Panel III risk calculator and coronary calcium screening with EBCT. The risk adjusted models incorporated the traditional risk factors for coronary heart disease and coronary calcium scores. The patients were followed for a mean of five years with a follow up rate of 100%. The results show that coronary calcification adds prognostic information that exceeds the knowledge of traditional risk factors and that the ability to classify and predict an event improved once the calcium scores were added to risk factors (Shaw et.al., 2003). This

study helps establish the importance of identifying cardiac risk factors and the coronary calcium score.

According to Taylor et al. (2005), "In young asymptomatic men, the presence of coronary artery calcification provides substantial, cost effective, and independent prognostic value in predicting incident CHD that is incremental to measured coronary risk factors." The researchers evaluated healthy men and women 40-50 years old. The participants had their coronary risk variables evaluated and coronary calcium was measured by EBCT. With an annual telephone follow up for 1-6 years, the participants were interviewed to discover if they had any coronary diseases or if sudden cardiac death had occurred. Coronary calcium was found in 22.4% of the men and in 7.9% of the women. Nine acute cardiac events occurred in men at a mean age of 46 years old. Seven of the men had coronary calcium and 2 of them did not. No events occurred in the women. Therefore, a conclusion could not be found for women. But for men with coronary artery calcification, the risk of coronary events increased and a family history of premature CHD also proved to be predictive of the incident events.

A study by Taylor et al. (2002) compared the relationships among physical activity, the cardiovascular risk factor profile, and the presence and extent of subclinical calcified coronary atherosclerosis in middle aged men and women. Physical activity information was obtained during an Army mandated physical exam. The subjects filled out a Baecke Physical Activity Questionnaire. This is a self reporting, 16 question questionnaire has three indices that are summed up to provide a composite Physical Activity Index (PI). The study found that physical activity was unrelated to the presence and extent of calcified subclinical atherosclerosis. Regular physical activity is associated

with a 30-50% reduction in CHD. Regular physical activity leads to a more positive cardiovascular risk factor profile and also lowers the risk of developing CHD. The authors stated that aerobic physical exercise favorably modifies multiple cardiovascular risk factors including blood pressure, LDL, triglycerides, fibrinogen, BMI, and insulin resistance. Therefore, these correlations suggest that the higher levels of physical activity would decrease the presence and extent of coronary atherosclerosis. However, when comparing the most sedentary and the most active patients, the prevalence of coronary calcium and the mean coronary calcium scores were similar. When controlling standard cardiovascular risk factors and physical activity in a multivariate model, only low density lipoprotein was associated with the presence of coronary calcium (Taylor et al., 2002).

A study by Detrano et al. (1999) showed that coronary calcium and cardiac risk factors were not associated with one another. The study was completed with 1,196 asymptomatic high coronary risk subjects with a mean age of 66 years. The subjects were classified as asymptomatic high coronary risk after undergoing risk factor assessment according to the Framingham Model and EBCT scanning. There was a follow up period of 41 months. The Framingham model and a data-derived risk model were used to determine the three year likelihood of a coronary event. In conclusion, the study found that neither risk factor assessment nor EBCT calcium was an accurate event predictor in high risk asymptomatic adults. The calcium score did not add significant information to risk factors, and therefore could not justify EBCT scans at the time of the study (Detrano et al.,1999). A study by Pitt and Rubenfire (1999) states that research that use classic risk models such as the Framingham or Multiple Risk Factor Intervention Trial have several flaws. They don't incorporate new risk factors such as diet, estrogens, personality traits

and physical activity. This study argues that the National Cholesterol Education Program Adult Treatment Panel II (ATP II) guidelines are reasonably effective at discriminating people at high risk that are destined to have an event, but more than half of the coronary deaths and the majority of the heart attacks in the United States occur in persons characterized as low or intermediate risk. After examining several studies, Pitt and Rubenfire (1999) conclude that the use of routine EBCT to risk stratify asymptomatic patients for future risk of ischemic events is not currently justified on a clinical basis. Pitt also suggests that "the physician community can do the most good by spending more time educating, risk-stratifying by standard guidelines, and supplementing with clinical judgment," (Pitt & Rubenfire, 1999, p. 2612).

Studies Exclusively Involving Men

In most of the research articles reviewed the majority of the subjects were men. For many years CHD has been thought of as primarily affecting men. Therefore, most research and testing has been done on men. One study specifically researched 73 pairs of age matched asymptomatic hypertensive or non-hypertensive men (Megnein, Simon, Lemariey, Plainfosse, & Levenson, 1996). The study also estimated the extent of peripheral atherosclerosis by ultra-fast CT scanning. All study subjects underwent an evaluation of traditional cardiovascular risk factors. The results of the study found that hypertensive men frequently had more coronary calcium, compared to non-hypertensive men. Hypertensive men showed correlations of calcium score with age and hypertension duration, but not with the increased level of blood pressure. The study found that duration of high blood pressure rather than the magnitude of elevation of the promotes the

presence and overall extent of coronary calcium (Megnein et al., 1996). Total cholesterol was not associated with coronary calcium score regardless of value, but it seemed to influence higher calcium scores between hypertensive patients with higher cholesterol and those with lower cholesterol. In comparison, HDL and LDL cholesterols and triglycerides, were not associated with coronary calcification; neither were risk factors such as body mass index, blood glucose and smoking (Megnein et al., 1996).

Studies Exclusively Involving Women

Research that specifically deals with coronary calcium and cardiac risk factors in women is sparse. Johns Hopkins Medical Institutions (2005) released a statement that "Traditional risk-factor scoring fails to identify approximately one-third of women likely to develop coronary heart disease (CHD)." Medical Doctor Roger Blumenthal, a cardiologist and the senior author of two studies completed at Johns Hopkins Medical Institution, feels that many women with cardiovascular problems go undetected despite the use of the Framingham score. He also stated that "While the death rate for men from cardiovascular disease has steadily declined over the last 20 years, the rate has remained relatively the same for women." In their latest report, as published by Johns Hopkins Medical Institutions (2005), researches examined the risk of premature CHD in women whose average age was 50 and who were participating in the Sibling and Family Heart Study. The subjects had no symptoms of heart disease but they had a sibling who had been hospitalized for a coronary event. Each woman's Framingham score was calculated and 98 percent were gauged to be at very low risk for future CHD, with a Framingham Risk Estimate (FRE) of less than six percent. Only two percent of the participants were

judged to be at intermediate risk for future CHD, with an FRE between 10 and 20 percent. When the results were compared with CT scan measurements of calcium build up in the arteries, the researchers found that one-third of the women originally classified as very low risk actually had coronary atherosclerosis. Indeed, 84 percent (408 of 489) of those classified as low risk by FRE actually had some coronary atherosclerosis. Twenty percent of those who were classified as intermediate risk by FRE had signs of advanced atherosclerosis. If the CT scan measurement had not been completed, many of the women would not have been considered for treatment. Due to this study, the Hopkins team began to search for additional predictors, even if they did have a low risk assessment. They found that people with two or more risk factors, such as obesity, smoking or metabolic syndrome, plus a family history for heart disease, were those most likely to have a high calcium score. They concluded that for some women, especially those with a family history of heart disease and multiple risk factors for CHD, additional screening using CT scanning and calcium scoring may be necessary (Johns Hopkins Medical Institutions, 2005).

One study analyzed estrogen status and its correlation with the calcium content of coronary atherosclerotic plaques in women (Christian et al., 2002). Coronary arteries were obtained from autopsies of 56 white women ages 18-98 years, 46 were postmenopausal and 10 were pre-menopausal. Medical records were reviewed for demographics, CHD risk factors, menstrual status and use of estrogen replacement therapy. Contact micro-radiography of coronary arteries assessed true calcium content and atherosclerotic plaque area. The calcium content of each section of the artery that underwent contact micro-radiography was analyzed by pixel count, as in computed

tomography and divided by millimeters squared to compute the calcium are. The study concluded that estrogen status was significantly associated with coronary calcium and plaque area independent of age and CHD risk factors. Therefore, estrogen may slow the progression of atherosclerosis in women (Christian et al., 2002).

According to the Agency for Healthcare Research and Quality (2005), much of the research in the last 20 years has either excluded women entirely or included only limited numbers of women in the research of the diagnosis and treatment of CHD. As a result, many of the tests and therapies used to treat women are based on studies conducted predominantly in men. Coronary heart disease causes more than 250,000 deaths in women each year. Experts estimate that one in two women will die of heart disease or stroke, compared with one in 25 women who will die of breast cancer. Forty-two percent of women who have had heart attacks, die within one year, compared with 24 percent in men (Agency for Healthcare Research and Quality, 2005). The explanation accepted by many is that women tend to get heart disease about 10 years later in life compared with men, and they are more likely to have coexisting, chronic conditions. However, research addressing women is still very important.

Conclusions

Throughout this literature review, there have been opposing views on the relationship of coronary calcium and traditional cardiac risk factors. There were numerous studies that described the association between coronary calcium and traditional cardiac risk factors (Oei et al., 2004; Wexler et al., 1996; Wilson et al., 1997; Megnein et al.,1996; Shaw et al., 2003; Johns Hopkins Medical Institutions, 2005; Moser et al., 2003;

Taylor et al., 2005). The risk factors that were most commonly associated with coronary calcium throughout the review of literature were systolic blood pressure, diastolic blood pressure, total cholesterol, high density lipoproteins (HDL), diabetes, family history of CHD, age and the male gender.

Conversely, there were other studies that found no association between coronary calcium and traditional cardiac risk factors (Taylor et al., 2002; Detrano et al.,1999; and Pitt & Rubenfire, 1999). The difference in the association between coronary calcium and cardiac risk factors may be due to the different levels of technology that were used in the various studies. Research is limited on coronary calcium and cardiac risk factors with women. There is a lack of studies on diagnostic testing, such as EBCT, that have been done specifically for women. According to Shaw et al. (2005, p.1), "Current approaches to diagnostic testing may need to be varied when applied to female patients. Investigation is needed to fully appreciate how women's hormones affect the vascular system and test results."

The most effective way to predict the relationship between coronary artery calcium and cardiac risk factors has not been defined. For this reason, the issue of coronary artery calcium and cardiac risk factors should be further investigated.

CHAPTER III

METHODOLOGY

It was the purpose of this study to assess the relationship between the coronary calcium score and traditional cardiac risk factors in men and women with no known cardiac disease. Specifically, are there gender differences in the risk factors that best predict high coronary calcium scores and are there gender differences in the number of risk factors that increase the presence of coronary calcium? It was hypothesized that there would be a positive relationship between the coronary calcium score and traditional cardiac risk factors in men and women with no known cardiac disease. It was also hypothesized that there would be gender differences in the risk factors that best predict high coronary calcium scores.

This study began in November 2005 and ended in June 2006. All of the participants had health assessment screenings performed through their participation in the "*Heart to Heart*" program sponsored by Sarah Bush Lincoln Health Center in Mattoon, Illinois. The participants also filled out a health questionnaire regarding traditional cardiac risk factors.

Description of Participants

Eighty-one Caucasian men and women, ages 30-70 years, with no known cardiac disease at the time the data were collected, volunteered for this study. Recruitment occurred by using voluntary participants of a health education program, "*Heart to Heart*", at Sarah Bush Lincoln Health Center (SBLHC) in Mattoon, Illinois. Subjects voluntarily

participated in the "*Heart to Heart*" program outside of this study. The subjects filled out a gender specific health questionnaire the day of the "*Heart to Heart*" program.

Measurements

Total cholesterol levels, blood glucose (fasting), height, weight, body mass index, CT/Calcium score, and blood pressure were obtained from health assessment screenings that were conducted by SBLHC staff prior to the day of the "*Heart to Heart*" program. Clinical measurements were obtained by a trained professional during a visit to Sarah Bush Lincoln Health Center. Cholesterol levels and blood glucose results were obtained from blood tests by venous draw. High cholesterol levels were defined as total serum values of > 200 mg· dL^{-1} ; LDL > 130 mg· dL^{-1} ; HDL < 40 mg· dL^{-1} ; and triglycerides > 150 mg· dL^{-1}. Blood glucose results were defined as a risk if fasting blood glucose was ≥ 100 mg dL or on medication which was self reported and BMI was calculated from measures of height (inches) and weight (lbs). Obesity was defined as a BMI > 30 kg/m^2. Blood pressures were measured with an automatic *Life Clinic*© sphygmomanometer with the patient in a seated position. Hypertension was defined as having a systolic blood pressure of ≥ 140 mmHg and/or a diastolic blood pressure of ≥ 90 mmHg. The patient was also diagnosed as hypertensive if they were on antihypertensive medication, which was self reported. The CT/Calcium score was obtained by the use of a *Siemens*© 4-slice Electron Beam CT (EBCT) Scanner.

The Electron Beam CT (EBCT) Scanner is one of the key instruments used by health care professionals to obtain the coronary calcium score. EBCT scanning is a type of CT scan that can detect atherosclerosis and coronary artery disease. According to RadiologyInfo (2005a), computed tomography (CT scanning) uses a machine with a

rotating gantry, an x-ray tube and multiple detectors that move around the body to obtain x-ray images. A CT scanner directs a series of x-ray pulses through the body, with each pulse only lasting a fraction of a second. This represents a "slice" of the organ or area being studied (Sarah Bush Lincoln Health System, 2005b). EBCT is much faster than a standard CT scan and it takes an accurate picture of an artery even while the heart is still beating (Sarah Bush Lincoln Health System, 2005a).

Each subject's risk for coronary artery disease was expressed as a coronary calcium score (Sarah Bush Lincoln Health System, 2005a). The coronary calcium score, derived from EBCT scans, is known to predict the occurrence of cardiac events, such as fatal and nonfatal heart attacks or the likelihood of needing coronary bypass surgery or coronary angioplasty over the next one or two years (American Heart Association, 2005b). According to SBLHC's website, research about the effectiveness of cardiac calcium scoring is limited; consequently, some health professionals disagree about the value of the test (2005b). However, according to Clouse (2006), it is appropriate to review and discuss how the coronary artery calcium examination may help in treating patients with subclinical atherosclerosis because it is the only noninvasive test available to evaluate insults to the arterial wall from all risk factors causing atherosclerosis. Clouse (2006) also states:

> Although there may be controversy over the use of the calcium score to diagnose obstructive disease, there is little controversy in its ability to detect calcified plaque. The ability of the CAC to estimate total plaque burden, ie, stage of disease, is the most significant predictor for future myocardial events. Therefore, the

> importance of the CAC score lies in its ability to identify individuals at risk and to integrate this information with other risk factors for risk stratification and goal directed prevention. (p.8)

For the purposes of this study, the calcium score was defined as:

0 = No calcium in the coronary arteries. Little chance that coronary artery disease is present.

0-10 = Small amount of calcium present in coronary arteries. Small risk of CAD may increase with age.

11-100 = Indicates a mild plaque build up in the coronary arteries. Risk for heart attack now is still low.

101-400 = Indicates that moderate to severe coronary artery disease is present. Aggressive risk reduction program should be developed along with further testing.

400+ = This result is a warning sign that severe coronary artery disease is present and you are at high risk for heart attack. Additional testing and aggressive risk management is indicated (RadiologyInfo , 2005a).

The risks of receiving the EBCT scan for CAD are minimal. Pregnant women should never have the test performed and were therefore excluded from participating in this study. The exam exposes the patient to a limited amount of radiation, similar to that from 10 chest x-rays and about 10-20% of that received during a diagnostic cardiac catheterization (CT) procedure. Cardiac CT sometimes produces a false positive test, even though there is no significant blockage of the coronary arteries. This could result in the patient undergoing further tests that are not necessary, and could cause side effects (RadiologyInfo, 2005a). Some other limitations of Cardiac CT for calcium scoring are that not all calcium deposits in the coronary arteries cause a blockage, and not all blocked arteries contain calcium. The earliest form of coronary artery disease, soft plaque, cannot

be detected by CT scanning. Furthermore, a high heart rate may interfere with the test. How the calcium score relates to the likelihood of experiencing angina, myocardial infarction, and sudden cardiac death is not fully understood at this time. Much research still needs to be done. Also, not all health insurance plans cover cardiac CT for calcium scoring. Men less than 35 years of age and women younger than 40 are not likely to benefit from cardiac CT for calcium scoring unless there are risk factors such as diabetes or a strong family history of heart disease. As a result of findings on cardiac CT, men older than 65 years and women older than 70 are not likely to be treated differently (RadiologyInfo, 2005a).

The subjects completed a short questionnaire on the first day of the "*Heart to Heart*" program that asked specific health questions according to gender (Appendix A & B). The questionnaire included health related questions to obtain information about risk factors for heart disease and medications the participants were taking. The following risk factors were self reported by the patient: family history, defined as a myocardial infarction, coronary revascularization, or sudden death before 55 years of age in father or other male first-degree relative, or before 65 years of age in mother or other female first-degree relative; cigarette smoking, defined as a current smoker or those who quit within the previous 6 months; and sedentary lifestyle, defined as a person not participating in a regular exercise program or not meeting the minimal physical activity recommendations of accumulating 30 minutes or more of moderate physical activity on most days of the week, from the U.S. Surgeon General's Report. Women were also asked if they had experienced or were currently experiencing menopause and if and how long they were taking medications or supplements for menopause. Women were also asked if they had

been diagnosed with osteoporosis and if and how long they had been taking medications or supplements.

Procedures

The health providers who conducted the "*Heart to Heart*" program at Sarah Bush Lincoln Health Center were contacted for permission to use their facility, resources, and participants to acquire information through a voluntary questionnaire. Men and women from the Coles County area, who had no known cardiac disease prior to receiving their health assessments, were selected. The health assessment screenings that were investigated in this study for men and women included: cholesterol levels, blood glucose (fasting), height, weight, body mass index, CT/Calcium score, blood pressure, age, and gender.

When the participants attended the "*Heart to Heart*" program to receive their results, they were asked to read and sign an informed consent (Appendix C) that explained the general purpose of the study, who the researcher was, and contact information. After they had given consent to allow their data to be used in this study, they were asked to thoroughly read and answer health specific questions. The questionnaires contained the same questions, except the women answered extra questions in regards to menopause and osteoporosis. The survey took approximately 5-10 minutes to complete. After the participants filled out the questionnaire, 100% of the questionnaires were returned to the primary investigator.

Data Analysis

Analysis focused on risk factor variables among all subjects and men and women separately. The number of risk factors that each female and male subject had was determined. After risk factor variables were determined, the number of subjects with one risk factor, two risk factors, or three or more risk factors were . Other analyses were conducted to determine which risk factors were associated with higher calcium scores. Each cardiac risk factor was analyzed, as well as gender specific factors such as pre-menopausal and post menopausal.

Descriptive statistics were calculated for all subjects and the men and women separately. The independent variables were age, number of risk factors that were self reported, systolic blood pressure (SBP), diastolic blood pressure (DBP), total serum cholesterol, high density lipoprotein (HDL), low density lipoprotein (LDL), serum triglycerides, blood glucose levels, body mass index (BMI), and minutes of exercise weekly. The coronary calcium score was the dependant variable.

The mean and standard deviation for each numerical self reported risk factor was calculated. Pearson Product-Moment correlations were performed to determine if there were significant correlations between age, number of risk factors, systolic blood pressure, diastolic blood pressure, total cholesterol, HDL, LDL, triglycerides, blood glucose levels, BMI, and total exercise minutes per week with coronary calcium. Pearson correlations were computed on all subjects as a combined group and for men and women separately. Independent t-tests were also performed to compare the means of each factor between the men and women ($p \leq .05$). Multivariate stepwise regression was completed using age, family history, number of risk factors, systolic blood pressure, diastolic blood pressure,

total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides, blood glucose levels, BMI, smoking, exercise minutes per week, occupational and recreational activity to predict coronary calcium for all subjects and for males and females separately. Significance was set at $p \leq .05$.

CHAPTER IV

RESULTS

This study was designed to determine the relationship between traditional cardiac risk factors in men and women with no known disease and the coronary calcium score and to determine if there were gender differences in the risk factors that best predict high coronary calcium scores. It was hypothesized that there would be a positive relationship between the coronary calcium score and traditional cardiac risk factors in men and women with no known cardiac disease. It was also hypothesized that there would be gender differences in the risk factors that best predict high coronary calcium scores. Descriptive statistics were calculated for all subjects and men and women separately. The independent variables were age, number of risk factors, systolic blood pressure (SBP), diastolic blood pressure (DBP), total serum cholesterol, high density lipoprotein (HDL), low density lipoprotein (LDL), serum triglycerides, blood glucose levels, body mass index (BMI), and minutes of exercise weekly. The coronary calcium score was the dependant variable.

The mean and standard deviation for each risk factor were calculated. Pearson Product-Moment correlations were performed to determine if there were significant relationships between age, number of risk factors, systolic blood pressure, diastolic blood pressure, total cholesterol, HDL, LDL, triglycerides, blood glucose levels, BMI, and total exercise minutes per week with coronary calcium. Pearson correlations were computed on all subjects as a combined group and for men and women separately. Significance was set at $p \leq .05$. Independent t-tests were used to compare means with each cardiac risk

factor for the men and women ($p \leq .05$). Multivariate stepwise regression was performed with age, family history, number of risk factors, systolic blood pressure, diastolic blood pressure, total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides, blood glucose levels, BMI, smoking, exercise minutes per week, occupational and recreational activity to predict a relationship with coronary calcium for all subjects and for males and females separately.

Descriptive Characteristics of Participants

Eighty-one men and women participated in the study. There were a total of 40 men and 41 women ranging in age from 30-70 years. The descriptive statistics for all subjects and men and women separately for age, number of risk factors, coronary calcium score, systolic blood pressure (SBP), diastolic blood pressure (DBP), total cholesterol, high density lipoprotein cholesterol (HDL), low density lipoprotein cholesterol (LDL), triglycerides, blood glucose levels, body mass index (BMI), and weekly exercise minutes are shown in Table 1.

Age, systolic blood pressure, diastolic blood pressure, and blood glucose levels were significantly related to coronary calcium in the combined group of men and women in the current study. At the time of the coronary calcium scan, 27.8% (n = 22) of the subjects had systolic blood pressure $\geq$ 140 mm Hg and 16.4% (n = 13) had a diastolic blood pressure $\geq$ 90 mm Hg. Five percent (n = 20) of the patients with high blood pressure at the time of the scan reported they were taking anti-hypertensive medications. Twenty two percent (n = 18) of the population self reported being diabetic and no subjects reported taking any type of diabetic medication

Table 1

Descriptive Statistics for All Subjects and Men and Women Separately

	Combined (n = 81)		Men (n = 40)		Women (n = 41)	
Variables	M	SD	M	SD	M	SD
Age (yrs)	55.52	±10.08	53.85	±9.99	57.15	±10.02
Number of Risk Factors	2.22	±1.41	2.13	±1.43	2.32	±1.40
Coronary Calcium Score	57.61	±161.62	85.37	±216.24	30.53	±71.61
SBP (mmHg[a])	131.08	±19.75	132.90	±18.35	129.21	±21.16
DBP (mmHg[a])	78.05	±11.81	82.98	±8.93	73.00	±12.36
Total Cholesterol ($mg \cdot dL^{-1}$)	198.44	±40.11	185.33	±35.99	211.24	±40.19
HDL ($mg \cdot dL^{-1}$)	50.19	±14.90	44.05	±10.61	56.17	±16.13
LDL ($mg \cdot dL^{-1}$)	124.70	±31.34	118.45	±32.76	130.80	±29.00
Triglycerides	120.09	±66.73	116.55	±67.33	123.54	±66.78
Blood Glucose (mg dL)	96.19	±15.41	96.13	±14.06	96.24	±16.80
BMI (kg/m^2)	28.41	±5.52	27.77	±3.53	29.02	±6.93
Exercise Minutes	116.58	±124.83	121.83	±127.54	111.46	±123.49

Note. SBP represents systolic blood pressure, DBP represents diastolic blood pressure, HDL represents high density lipoprotein, LDL represents low density lipoprotein, BMI represents body mass index, and exercise minutes represent total minutes of exercise per week.

[a] n = 79 subjects for combined group and n=39 subjects for females due to missing data

Twenty five point nine percent (n = 21) of the subject population had HDL values < 40 mg· dL^{-1} compared to 40% (n = 16) of the men and only 12.2% (n = 5) of women. LDL values > 130 mg· dL^{-1} were found in 43.2% (n = 35) of all subjects, 35% (n = 14) of men and 51.2% (n = 21) of the women. Triglyceride levels of > 150 were seen in 27.1% (n = 22) of all subjects, 20 % (n = 8) of the men and 34.1% (n = 14) of the women. There were few smokers with only 4.9% (n = 4) of all subjects, 5% (n = 2) of men and 4.8% (n = 2) of women. Obesity defined as a BMI> 30 kg/m^2, was found in 32.1% (n = 26) of all subjects, 27.5% (n = 11) in men and 36.5% (n = 15) in women. The percent of the population that had three or more risk factors was 39.5% (n = 32), those with two risk factors was 28.3% (n = 23), those with one risk factor represented 20.9% (n = 17) and only 11.1% (n = 9) had zero risk factors. For women those with three or more risk factors was 41% (n = 17), two risk factors was 32% (n = 13) one risk factor was 17% (n = 7) and 10% (n = 4) of the women had zero risk factors. The men had similar results with 37.5% (n = 15) having three or more risk factors, 25% (n = 10) having two risk factors, 25% (n = 10) having one risk factor, and 12.5% (n = 5) of the men had zero risk factors.

In the combined population, 48.1% (n = 39) of the subjects exercised 0-100 minutes per week with 45% (n = 18) of men compared to 51.2% (n = 21) of women. Of these subjects, 38.27% (n = 31) exercised for zero minutes per week, 35% (n = 14) men and 41.46% (n = 17) of women. Exercise for 101-200 minutes per week was performed by 29.6% (n = 24) of the combined population compared with 30% (n = 12) of the men and 29.3% (n = 12) of the women. Thirteen point five percent (n = 11) of the combined population, 17.5% (n = 7) of men and only 10% (n = 4) of women exercised for 201-300

minutes per week. The combined population that exercised 301-400 minutes per week was 6.17% (n = 5), with only 7% (n = 3) of women compared with 17.5% (n = 2) of the men. In all subjects, 1.23% (n = 1) exercised for 401-500 minutes per week, 2% (n = 1) of women and 0% (n = 0) of men. In the final exercise minute category, 1.23% (n = 1) of the combined group exercised for 501-600 minutes, with 2.5% (n = 1) of men exercising for this many minutes per week. Thirty-three point three percent (n = 27) of the combined population participated in occupational or recreational activities. Forty six point one percent of men (n = 18) and 21.9% (n = 9) of women participated in occupational and recreational activities.

Gender

The coronary calcium scores for the current study ranged from 0 to 1277. Fifty four point three percent of all participants (n = 44) had a coronary calcium score of zero. When comparing gender, 42.5% (n = 17) of men and 65.8% (n = 27) of women had zero coronary calcium. Overall, 28.3% (n = 23) of all participants had a coronary calcium score > 0 but ≤ 100, including 37.5% (n = 15) of the men and 19.5% (n = 8) of the women. Sixteen percent of the participants (n = 13) had a score >100 but ≤ 400, including 17.5% (n = 7) of men and 14.6% (n = 6) women. Only 1.23% of the entire population (n = 1) had a high risk coronary calcium score > 400, including 2.5% (n = 1) of the men and 0% (n = 0) of the women. When the women were separated from all subjects, age and blood glucose level were significantly correlated with coronary calcium. The women participants, 41.4% (n = 17), were 60 years and older compared with only 25% (n = 10) of the men in the current study.

Comparisons Between Men and Women

Independent t-tests were performed to compare the men and women for the variables age, number of risk factors, coronary calcium score, systolic blood pressure (SBP), diastolic blood pressure (DBP), total cholesterol, high density lipoprotein cholesterol (HDL), low density lipoprotein cholesterol (LDL), triglycerides, blood glucose levels, body mass index (BMI), and weekly exercise minutes. Diastolic blood pressure ($t(1,77) = 16.94$, $p = .000$), total cholesterol ($t(1,79) = 9.33$, $p = .003$), and HDL cholesterol levels ($t(1,79) = 15.87$, $p = .000$) were significantly different between the men and women. Men had higher DBP values whereas the women had significantly higher total cholesterol and HDL levels than the men.

Correlations Between Risk Factors and Coronary Calcium for All Subjects

Pearson Product-Moment correlations were performed to determine if there were significant relationships ($p \leq .05$) between age, number of risk factors, SBP, DBP, total cholesterol, HDL, LDL, triglycerides, blood glucose levels, BMI, and weekly exercise minutes with coronary calcium. Correlations analyzed for all subjects are shown in Table 2. Significant relationships were found for age, SBP, DBP and blood glucose with coronary calcium.

Correlations Between Risk Factors and Coronary Calcium for Men

Pearson Product-Moment correlations between risk factors and coronary calcium were run to determine significance ($p \leq .05$) on men (Table 3). Systolic blood pressure and diastolic blood pressure were the only factors that showed a significant relationship to coronary calcium. Age, number of risk factors, total cholesterol, HDL, LDL,

triglycerides, blood glucose, BMI and weekly exercise minutes showed an insignificant relationship.

Correlations Between Risk Factors and Coronary Calcium For Women

Pearson Product-Moment correlations between risk factors and coronary calcium for women are shown in Table 4. Significant correlations ($p \leq .05$) were observed for age and blood glucose levels. Number of risk factors, SBP, DBP, total cholesterol, HDL, LDL, triglycerides, BMI, and weekly exercise minutes had insignificant relationships with coronary calcium.

Table 2

Correlations Between Risk Factors and Coronary Calcium for All Subjects

	Coronary Calcium		
Variable	Subjects (n)	Correlation (r value)	Significance (p value)
Age (yrs)	81	.235	.034 *
Number of Risk Factors	81	.134	.234
SBP (mmHg)	79	.367	.001 *
DBP (mmHg)	79	.247	.028 *
Total Cholesterol ($mg \cdot dL^{-1}$)	81	.093	.407
HDL ($mg \cdot dL^{-1}$)	81	-.026	.816
LDL ($mg \cdot dL^{-1}$)	81	.075	.507
Triglycerides	81	.151	.179
Blood Glucose (mm dL)	81	.256	.021 *
BMI (kg/ m^2)	81	-.042	.711
Exercise Minutes	81	.062	.581

Note. * Indicates a significant correlation ($p \leq .05$). SBP represents systolic blood pressure, DBP represents diastolic blood pressure, HDL represents high density lipoprotein, LDL represents low density lipoprotein, BMI represents body mass index, and exercise minutes represent total minutes of exercise per week.

Table 3

Correlations Between Risk Factors and Coronary Calcium in Men

	Coronary Calcium			
Variable	Subject (n)	Correlation (r value)	Significance (p value)	
Age (yrs)	40	.244	.130	
Number of Risk Factors	40	.143	.380	
SBP (mmHg)	40	.494	.001	*
DBP (mmHg)	40	.331	.037	*
Total Cholesterol (mg· dL^{-1})	40	.203	.209	
HDL (mg· dL^{-1})	40	.100	.539	
LDL (mg· dL^{-1})	40	.105	.518	
Triglycerides	40	.193	.232	
Blood Glucose (mm dL)	40	.286	.074	
BMI (kg/ m^2)	40	-.090	.581	
Exercise Minutes	40	.023	.890	

Note. * Indicates a significant correlation ($p \leq .05$). SBP represents systolic blood pressure, DBP represents diastolic blood pressure, HDL represents high density lipoprotein, LDL represents low density lipoprotein, BMI represents body mass index, and exercise minutes represent total minutes of exercise per week.

Table 4

Correlations Between Risk Factors and Coronary Calcium in Women

	Coronary Calcium		
Variable	Subjects (n=)	Correlations (r value)	Significance (p value)
Age (yrs)	41	.481	.001 *
Number of Risk Factors	41	.231	.146
SBP (mmHg)	39	.204	.213
DBP (mmHg)	39	.046	.780
Total Cholesterol ($mg \cdot dL^{-1}$)	41	.135	.401
HDL ($mg \cdot dL^{-1}$)	41	-.012	.940
LDL ($mg \cdot dL^{-1}$)	41	.180	.261
Triglycerides	41	.135	.359
Blood Glucose (mm dL)	41	.358	.022 *
BMI (kg/m^2)	41	.054	.736
Exercise Minutes	41	.183	.253

Note. * Indicates a significant correlation ($p \leq .05$). SBP represents systolic blood pressure, DBP represents diastolic blood pressure, HDL represents high density lipoprotein, LDL represents low density lipoprotein, BMI represents body mass index, and exercise minutes represent total minutes of exercise per week.

Multivariate Stepwise Regression

Multivariate stepwise regression analysis was performed on all subjects. Risk factors were entered in a step-wise order to determine which risk factors significantly contribute to the model to predict CAC. The analysis showed that SBP was the only significant predictor of coronary calcium (Table 5).

Table 5

Multivariate Stepwise Regression Analysis for Systolic Blood Pressure with All Subjects

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	281699.738	1	281699.738	11.871	0.001
	Residual	1803542.217	76	23730.819		
	Total	2085241.955	77			

No other risk factor variables contributed significantly to the model for CAC (Table 6).

When the data from the men were analyzed with multivariate stepwise regression (Table 7), the only significant predictor was SBP ($p = .001$).

Table 6

Excluded Variables for Multivariate Stepwise Regression with All Subjects

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	Age	0.191	1.800	0.076	0.203	0.978
	FamilyHx	0.076	0.704	0.484	0.081	0.985
	DBP	-0.025	-0.167	0.868	-0.019	0.501
	TC	0.126	1.184	0.240	0.135	0.996
	LDL	0.083	0.776	0.440	0.089	1.000
	HDL	0.045	0.417	0.678	0.048	0.972
	TRIG	0.157	1.486	0.142	0.169	1.000
	Diabetes	0.146	1.285	0.203	0.147	0.880
	BMI	-0.196	-1.730	0.088	-0.196	0.865
	Smoking	-0.071	-0.658	0.512	-0.076	0.977
	ExMin	0.107	0.991	0.325	0.114	0.984
	OccRecAct	-0.139	-1.307	0.195	-0.149	0.994
	NumRF	-0.049	-0.401	0.690	-0.046	0.774

Note. FamilyHx represents family history, DBP represents diastolic blood pressure, TC represents total cholesterol, LDL represents low density lipoprotein, HDL represents high density lipoprotein, TRIG represents triglycerides, BMI represents body mass index, exercise minutes represent total minutes of exercise per week, OccRecAct represents involvement in occupational or recreational activities and NumRF represents the number of risk factors.

Table 7

Multivariate Stepwise Regression Analysis for Systolic Blood Pressure with Men

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	446166.709	1	446166.709	11.994	0.001
	Residual	1376315.407	37	37197.714		
	Total	1822482.117	38			

Table 8 shows that no other variables were significant ($p \geq .05$).

Table 8

Excluded Variables for Multivariate Stepwise Regression with Men

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	Age	0.154	1.057	0.297	0.174	0.958
	FamHx	0.126	0.878	0.386	0.145	1.000
	DBP	-0.055	-0.263	0.794	-0.044	0.480
	TC	0.154	1.074	0.290	0.176	0.990
	LDL	0.077	0.536	0.595	0.089	0.997
	HDL	0.076	0.525	0.603	0.087	0.998
	TRIG	0.165	1.161	0.253	0.190	0.996
	Diabetes	0.162	1.096	0.281	0.180	0.923
	BMI	-0.213	-1.476	0.149	-0.239	0.946
	Smoking	-0.010	-0.070	0.945	-0.012	0.962
	ExMin	0.120	0.820	0.418	0.135	0.964
	OccRecAct	-0.220	-1.531	0.135	-0.247	0.958
	NumRF	-0.132	-0.800	0.429	-0.132	0.753

Note. FamilyHx represents family history, DBP represents diastolic blood pressure, TC represents total cholesterol, LDL represents low density lipoprotein, HDL represents high density lipoprotein, TRIG represents triglycerides, BMI represents body mass index, exercise minutes represent total minutes of exercise per week, OccRecAct represents involvement in occupational or recreational activities and NumRF represents the number of risk factors.

The data from the women were analyzed with multivariate stepwise regression and age was the only variable found to significantly predict coronary calcium (Table 9).

Table 9

Multivariate Stepwise Regression Analysis for Age with Women

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	48915.222	1	48915.222	11.656	.002
	Residual	155268.895	37	4196.457		
	Total	204184.117	38			

The Multivariate Stepwise Regression model did not show any significance for other risk factors (Table 10).

Table 10

Excluded Variables for Multivariate Stepwise Regression with Women

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	FamilyHx	-0.261	-1.834	0.075	-0.292	0.951
	SBP	0.140	0.963	0.342	0.158	0.981
	DBP	0.089	0.616	0.541	0.102	0.992
	TC	0.081	0.555	0.582	0.092	0.982
	LDL	0.156	1.088	0.284	0.178	0.997
	HDL	-0.054	-0.372	0.712	-0.062	0.986
	TRIG	0.063	0.429	0.670	0.071	0.963
	Diabetes	0.270	1.910	0.064	0.303	0.960
	BMI	0.184	1.264	0.214	0.206	0.952
	Smoking	-0.198	-1.391	0.173	-0.226	0.989
	ExMin	0.115	0.789	0.435	0.130	0.984
	OccRecAct	-0.014	-0.098	0.922	-0.016	0.990
	NumRF	0.217	1.537	0.133	0.248	0.998

Note. FamilyHx represents family history, SBP represents systolic blood pressure, DBP represents diastolic blood pressure, TC represents total cholesterol, LDL represents low density lipoprotein, HDL represents high density lipoprotein, TRIG represents triglycerides, BMI represents body mass index, exercise minutes represent total minutes of exercise per week, OccRecAct represents involvement in occupational or recreational activities and NumRF represents the number of risk factors.

Summary

Descriptive statistics were calculated for all subjects and the men and women separately. The independent variables were age, number of risk factors that were self reported, systolic blood pressure (SBP), diastolic blood pressure (DBP), total serum cholesterol, high density lipoprotein (HDL), low density lipoprotein (LDL), serum triglycerides, blood glucose levels, body mass index (BMI), and minutes of exercise weekly. The coronary calcium score was the dependant variable.

Independent t-tests were performed to compare means between men and women for the variables age, number of risk factors, coronary calcium score, systolic blood pressure (SBP), diastolic blood pressure (DBP), total cholesterol, high density lipoprotein cholesterol (HDL), low density lipoprotein cholesterol (LDL), triglycerides, blood glucose levels, body mass index (BMI), and weekly exercise minutes. Men had significantly higher DBP values than women, while the women had significantly higher total cholesterol and HDL levels than the men.

Pearson Product-Moment correlations were performed to determine if there were significant relationships between age, number of risk factors, systolic blood pressure, diastolic blood pressure, total cholesterol, HDL, LDL, triglycerides, blood glucose levels, BMI, and total exercise minutes per week with coronary calcium. In the combined group, a significant positive correlation was seen between the variables of age, SBP, DBP, and blood glucose levels with coronary calcium. When observing the Pearson Product-Moment correlations between variables and coronary calcium in the men, SBP and DBP were significantly correlated. Among the women, age and blood glucose levels were significantly correlated with coronary calcium. When Multivariate Stepwise Regression

was computed for the subject data, the combined group and men showed the SBP to be the only significant contributor to the regression model for coronary calcium. The women showed significance only with age as a significant contributor to the regression model.

CHAPTER V

SUMMARY, DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to determine the relationship between coronary calcium and traditional cardiac risk factors in men and women with no known cardiac disease. A second purpose was to determine if there were gender differences in the risk factors that best predict high coronary calcium scores. It was hypothesized that there would be a positive relationship between the coronary calcium score and traditional cardiac risk factors in men and women with no known cardiac disease. It was also hypothesized that there would be gender differences in the risk factors that best predict high coronary calcium scores.

There has been widespread research examining this relationship involving both men and women. The literature review contained research studies that included asymptomatic patients, symptomatic patients, populations that were at high risk for coronary heart disease (CHD), and populations that were associated with low CHD risk. After reviewing the literature, no consensus could be established in predicting the relationship between coronary artery calcium and cardiac risk factors.

Summary

In the current study, it was observed that age, systolic blood pressure, diastolic blood pressure, and blood glucose levels were significantly related to coronary calcium in the combined group of men and women. No other risk factor variables were significantly

related with coronary calcium among all subjects. Differences in coronary calcium scores between men and women were found to be insignificant. Among the men, systolic blood pressure and diastolic blood pressure were the only risk factors that were significantly associated with coronary calcium. Data from the women showed that, age and blood glucose level were significantly related to the calcium score.

Discussion

According to Wexler et al. (1996), in a statement made for health professionals from the American Heart Association, several investigators have studied risk factors and their association with coronary artery calcifications. Some findings are similar to the results of the current study. Wexler et al. (1996) reported that some of the risk factors that have been shown to be associated with coronary calcification, in one or more studies in one or more patient groups, were age, elevated blood pressure, and diabetes.

Gender

Differences in coronary calcium scores between men and women were found to be insignificant. Similar results were seen in a study by Newman et al. (2001). Nine percent (n = 57) of the participants had a coronary calcium score of zero, 6% of men compared with 11.4% of women. An additional 21.7% (n = 133) of the participants had a score < 100 and 54.7% (n = 336) had a score < 400. Fewer women than men had a score > 1000, 13% of women compared with 34% of men.

Through his review of several studies, Wexler et al. (1996) found other cardiac risk factors to be associated with coronary calcium. It was found that age and gender

were the most important risk factors for coronary calcification while cigarette smoking, obesity, number of risk factors, diminished HDL cholesterol levels and elevated triglycerides were also reported as being associated with coronary calcium in one or more studies. Wexler also reported that the most common associated risk factor for CHD and coronary calcium was elevated plasma cholesterol.

The current study failed to find significance between the above mentioned cardiac risk factors and coronary calcium in the combined group. An explanation for finding no significance may be due to a low number of subjects participating in the study or that the subjects self reported their risk factors. Almost 40% (n = 32) of the subjects had three or more risk factors. It is a possibility that the subjects incorrectly reported their risk factors. Also, the duration associated with each risk factor was not measured. The span of time a person has a risk factor may play a role in how damaging the risk factor can be and how significant of a role it plays in the development of coronary calcium. The duration of each risk factor may not have been long enough to cause a significant relationship with coronary calcium.

Age was found to be significantly related with the coronary calcium score in all subjects, but when the combined group was separated, age only remained a factor for women. The mean age of the subjects that participated in the study was 55.52 years. Other studies in the literature with similar results consisted of older populations. In the present study, the mean age of the women when the coronary calcium was calculated was 57.15 years and for men was 53.85. The difference of two years between the men and women's age category may be a reason no correlation was found. A positive correlation was found with women's age and coronary calcium. In this study, age may have been a

factor for women and not men due to a smaller percent of men in the older age group. The results of the study completed by Wexler et al. (1996) supports this finding. Wexler et al. (1996) found that there was a 14% risk for developing coronary calcification for men and women less than 40 years old and a 93% to 100% risk for men older than 70 years old, and a 77% to 100% risk for women older than 70 years old. In another study completed by Devries et al. (1995), it was found that younger women have a unique pattern of calcification which more closely resembles the male pattern only after women reach 60 years of age. The study also found that coronary atherosclerosis in men is more likely to be associated with calcification than similarly diseased arteries in women. The women in Devries et al. (1995) study that were > 60 years old had a calcification pattern indistinguishable from that in men of any age. Younger women have been found to produce less coronary calcification than younger men in the same age group, but this difference is reduced as women age. Data from the women also found blood glucose levels to be significantly related to the calcium score. Significant correlations between blood glucose levels and CAC found in women and not men could be because women had higher levels of blood glucose than the men. The maximum level of blood glucose for the women was 165 mg dL compared to 139 mg dL in men. This again suggests the idea of the magnitude of each risk factor playing a role in the development of coronary artery calcification. The results of the current study suggest that the magnitude of a risk factor is closely related with the risk factor relationship with coronary calcium.

Non-Significant Risk Factors

No significant relationships were found in the combined group of men and women and or by gender with the risk factors of HDL, LDL, triglyceride levels, obesity, number of risk factors, physical activity, family history and coronary calcium. Conflicting results were found in a study completed by Moser, O'Keefe, Bateman, and McGhie (2003) who examined the number of risk factors that are related to coronary artery calcification (CAC). They performed retrospective analysis on data from 794 asymptomatic patients who underwent CAC screening over an eight month period. Subjects were risk stratified according to the number of risk factors. Patients in this study with three or more cardiac risk factors were more likely to exhibit moderate to severe CAC.

A study by Taylor et al. (2002) also found that physical activity was unrelated to the presence and extent of calcified subclinical atherosclerosis. This is somewhat surprising since regular physical activity is associated with a 30-50 % reduction in CHD. Regular physical activity leads to a more positive cardiovascular risk factor profile and also lowers the risk of developing CHD. The authors stated that aerobic physical exercise favorably modifies multiple cardiovascular risk factors including blood pressure, LDL, triglycerides, fibrinogen, BMI, and insulin resistance. These correlations suggest that the higher levels of physical activity would decrease the presence and extent of coronary atherosclerosis. Although the current study failed to support this suggestion, the reason for the insignificant relationship may be because other risk factors out weigh the benefits of physical activity in relationship to coronary calcium because 48.1% (n = 81) of the current study's population had limited exercise of only 0-100 minutes per week.

Differing results were found in subjects with a family history of CHD. According to Taylor et al. (2005) in men with coronary artery calcification, the risk of coronary events and a family history of premature CHD proved to be predictive of the incident events. The current study did not follow up with each patient to learn of any events or coronary disease that developed or occurred after the data was collected. The current study failed to find a significant relationship with family history and coronary calcium.

The possible reason that no significant differences were found between other risk factors besides age, systolic blood pressure, diastolic blood pressure and blood glucose levels in the combined group may also be due to the low number of participants. Another factor that may have limited the results may have to do with the values of each risk factor and the length of time each participant had a certain risk factor. Other studies found total cholesterol to be correlated with coronary calcium, but in the current study, it is possible that the subjects who had high cholesterol may not have had high enough levels or not had high enough levels for a long enough period of time to be correlated with coronary calcium. This may also be a factor for HDL levels, LDL levels, blood glucose levels, and BMI. Some reasons that no significant difference was found in the male subjects between cardiac risk factors other than systolic and diastolic blood pressure and coronary calcium may also be due to the small population size, younger men participating in the study, and low total cholesterol, HDL, LDL, blood glucose levels and BMI The reason no significant difference was found in the female subjects between cardiac risk factors other than age and blood glucose with coronary calcium could be due to the same factors as the men. Other possibilities are that the risk factor values of the current study's population may not be at a level to cause calcification in the coronary artery, and the

duration of each risk factor is not known. Similar research has shown significance with certain risk factors and not others and this may be due to many of the above possibilities.

Conclusions

The purpose of this study was to determine the relationship between coronary calcium and traditional cardiac risk factors in men and women with no known cardiac disease. It was hypothesized that there would be a positive relationship between the coronary calcium score and traditional cardiac risk factors in men and women with no known cardiac disease. It was also hypothesized that there would be gender differences in the risk factors that best predict high coronary calcium scores. The current study supports the first hypothesis with a significant relationship found between the risk factors age, SBP, DBP and blood glucose with coronary calcium in all subjects. Systolic blood pressure and diastolic blood pressure were the only factors that showed a significant relationship to coronary calcium in the male group.

As hypothesized, the current study found that there are gender differences in the risk factors that best predict high coronary calcium scores. A significant difference between males and females was observed between DBP, total cholesterol, and HDL cholesterol levels. Males had higher DBP values whereas the females had significantly higher total cholesterol and HDL levels than the males. The female risk factors of age and blood glucose levels and the male group risk factors of SBP and DBP were the only factors that showed a significantly positive relationship to coronary calcium. Based on the results of this study, women with the risk factors of increasing age and high blood fasting glucose and men with the risk factors of high systolic blood pressure and high

diastolic blood pressure should have a coronary calcium test performed to determine prevention or treatment methods.

Recommendations for Future Research

The results of the current study may have an impact for individuals with certain risk factors. Some traditional cardiac risk factors have proven to be related with coronary calcium not only in the current study but also in the reviewed literature. Although the current study did find significant relationships between certain risk factors and coronary calcium it is still indefinite as to which risk factors may have the greatest effects on coronary calcium and further research should be completed.

Based on the findings of this study, the following recommendations appear warranted:

1. A similar study should be conducted using a larger sample size.
2. A similar study should be conducted with more diverse populations as to ethnicity and range of risk factors.
3. A similar study should be conducted with an older population.
4. A similar study should be conducted with participants over time to determine how long they have had risk factors.
5. A similar study should be conducted and the value of risk factors should be assessed.

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APPENDIX A

Men's Health Questionnaire

Name: _____

	Circle Answer
1. Have you been diagnosed with high blood pressure?	Yes No
If yes, are you currently taking medication?	Yes No
If yes, how long have you been on medication? _____	
2. Have you been diagnosed with diabetes?	Yes No
If yes, are you currently taking medication?	Yes No
If yes, how long have you been on medication? _____	
3. Have you been diagnosed with high cholesterol and/ or triglycerides?	Yes No
If yes, are you currently taking medication?	Yes No
If yes, how long have you been on medication? _____	
4. Do you currently smoke cigarettes?	Yes No
If yes, how much do you smoke per day?	Packs/Day ___
How many years have you smoked?	# years ___
5. Have you quit smoking with in the past 6 months?	Yes No
6. Do you currently exercise?	Yes No
If yes, how many days per week?	Days/wk ___
How many minutes each session?	Minutes ___
7. What type of exercise do you engage in?	Please Check All That Apply

[ ] Walking [ ] Cycling

[ ] Jogging [ ]Swimming

[ ] Aerobics [ ] Weight Training

Other: _____

Please continue on back

8. Do you participate in occupational or recreational activities? Yes No

If yes, please explain. _____

_____

9. Do you have a family history of heart disease? Yes No

If yes, please circle your answers accordingly.

Mycoardial infarction, coronary revascularization, or sudden death before 55 years of age in father or brother? Yes No

Myocardial infarction, coronary revascularization, or sudden death before 65 years of age in mother or sister? Yes No

Thank you for your participation!
Please make sure you put your name on the front page.

APPENDIX B

Women's Health Questionnaire

Name: _____

	Circle Answer	
1. Have you been diagnosed with high blood pressure?	Yes	No
If yes, are you currently taking medication?	Yes	No
If yes, how long have you been on medication? _____		
2. Have you experienced/are you currently experiencing menopause?	Yes	No
If yes, are you currently taking medication/supplements?	Yes	No
If yes, how long have you been on medication/supplements? _____		
3. Have you been diagnosed with diabetes?	Yes	No
If yes, are you currently taking medication?	Yes	No
If yes, how long have you been on medication? _____		
4. Have you been diagnosed with high cholesterol and/ or triglycerides?	Yes	No
If yes, are you currently taking medication?	Yes	No
If yes, how long have you been on medication? _____		
5. Have you been diagnosed with osteoporosis?	Yes	No
If yes, are you currently taking medication/supplements?	Yes	No
If yes, how long have you been on medication/supplements? _____		
6. Do you currently smoke cigarettes?	Yes	No
If yes, how much do you smoke per day?	Packs/Day _____	
How many years have you smoked?	# years _____	
7. Have you quit smoking with in the past 6 months?	Yes	No

Please Continue On Back

8. Do you currently exercise? Yes No

If yes, how many days per week? Days/wk _____
How many minutes each session? Minutes _____

What type of exercise do you engage in? Please Check All That Apply

[ ] Walking [ ] Cycling

[ ] Jogging [ ]Swimming

[ ] Aerobics [ ] Weight Training

Other: _____

9. Do you participate in occupational or recreational activities? Yes No

If yes, please explain. _____

_____

10. Do you have a family history of heart disease? Yes No

If yes, please circle your answers accordingly.

Mycoardial infarction, coronary revascularization, or sudden death before 55 years of age in father or brother? Yes No

Myocardial infarction, coronary revascularization, or sudden death before 65 years of age in mother or sister? Yes No

Thank you for your participation!
Please make sure you put your name on the front of the page.

APPENDIX C

CONSENT TO PARTICIPATE IN RESEARCH

You are invited to participate in a research study conducted by Tasha Thursby, graduate student in exercise science and Dr. Jill Owen, from the Physical Education Department at Eastern Illinois University. Your participation in this study is entirely voluntary. Please ask questions about anything you do not understand, before deciding whether or not to participate.

• PURPOSE OF THE STUDY

To determine the relationship of the Coronary Calcium Score with traditional cardiac risk factors in men and women with no known cardiac disease.

• PROCEDURES

If you volunteer to participate in this study, you will be asked to:

- Fill out a short questionnaire about your current health and health related behaviors.
- Allow the use of your health information from the Heart to Heart program conducted by Sarah Bush Lincoln Health Center to be used in this research.

• POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

The benefits that are expected from the research will not directly benefit you. The potential benefits to science and/or society are to discover if there are any specific cardiac risk factors or a specific group of risk factors that can predict high coronary calcium scores. These results could help in determining if a person is at risk of developing cardiac disease and it could offer suggestions for either prevention or treatment.

• CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of the researcher. The information will be stored in a safe filing cabinet and the only persons that will have access to the information will be the researcher and the faculty sponsor.

The information will not be released to any other party for any reason. The use of names will not be permitted or released to any person or agency. The nature of the information and the purpose of the research will remain completely confidential.

• PARTICIPATION AND WITHDRAWAL

Participation in this research study is voluntary and not a requirement or a condition for being the recipient of benefits or services from Eastern Illinois University or any other organization sponsoring the research project. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind or loss of benefits or services to which you are otherwise entitled.
You may also refuse to answer any questions you do not want to answer.

• IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about this research, please contact

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• RIGHTS OF RESEARCH SUBJECTS

If you have any questions or concerns about the treatment of human participants in this study, you may call or write:

Institutional Review Board
Eastern Illinois University
600 Lincoln Ave.
Charleston, IL 61920
Telephone: (217) 581-8576
E-mail: eiuirb@www.eiu.edu

You will be given the opportunity to discuss any questions about your rights as a research subject with a member of the IRB. The IRB is an independent committee composed of members of the University community, as well as lay members of the community not connected with EIU. The IRB has reviewed and approved this study.

I voluntarily agree to participate in this study. I understand that I am free to withdraw my consent and discontinue my participation at any time. I have been given a copy of this form.

_____
Printed Name of Participant

_____ _____
Signature of Participant Date